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Technical Report 414

PROJECT SEA HUNT FY 78 FINAL REPORT

J. V. SIMMONS, Jr.

March 1979

NAVAL OCEAN SYSTEMS CENTER
SAN DIEGO, CALIFORNIA 92152

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA 92152

AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

RR GAVAZZI, CAPT, USN
Commander

HL BLOOD
Technical Director

ADMINISTRATIVE INFORMATION

The work reported herein was sponsored by Independent Research (IR) funds of the Naval Ocean Systems Center. Tests of Sea Hunt by the Coast Guard were sponsored by the Coast Guard Research and Development Office from the Division of Safety and Advanced Technology.

Special thanks are due to the personnel of the Kaneohe Marine Corps Air Station's Station Operations and Maintenance Squadron. Their enthusiastic, dedicated participation in providing over 200 flight hours leading to the successful test of Sea Hunt is sincerely appreciated.

Likewise, the personnel of the Barbers Point Coast Guard Air Station are recognized for the flight time, support, and constructive thinking provided during their involvement with the tests of Sea Hunt. Their participation was invaluable.

The author also wishes to express gratitude to those persons within NOSC who have provided guidance, optimism, support, and labor during the development of Sea Hunt.

Released by
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Bioacoustics & Bionics Division

Under authority of
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The unique sensory and behavioral abilities of pigeons have been field tested, using three trained specimens for aerial reconnaissance. Their abilities have proven in field tests to be directly applicable as an aid to search and rescue missions. This report presents the methodology and results of the field tests. The results of this effort will provide information necessary in the planning of future development and use of the Sea Hunt System by the Navy and Coast Guard.

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INTRODUCTION

As the result of a two-day, NOSC-sponsored workshop in 1976, a proposal was made that trained pigeons (*Columba livia*) be used as an aid to the crew of an aircraft on a daylight search mission. The pigeon is better suited to visual searches than man. A major difference between man's vision and that of the pigeon, based on retinal structure and behavioral studies, is that the pigeon has a superior search rate ability, being able to process acutely a much larger proportion of the visual field than man in the same amount of time. (Benggeli 1969, Blough 1977, Pumphrey 1961).

A prototype system was designed in July 1976. Three birds would be comfortably positioned in separate compartments in an observation chamber attached to the underside of a helicopter, trained to detect orange objects on the ocean surface, and to indicate the presence of such an object by pecking a response key. An auditory signal would alert the operator in the helicopter to observe a visual display of the response, indicating the direction in which to concentrate the search.

A study was then begun to determine whether the unaided visual abilities of the pigeon could be used to detect the presence of an object on the surface of the ocean at the distances required during aerial searches. Results obtained from July 1976 to October 1977 indicated that the proposed application had a high probability of success. Through operant conditioning procedures, four birds were trained to vigilantly search the surface of the ocean and reliably detect the infrequent presentation of orange colored targets up to a distance of almost 700 metres. Each target was 36 centimetres square, about the same surface area as that of a man wearing an inflated life preserver. During each daily, two-hour session, detection latencies and false reports were low, despite the fact that the probability of a target occurring was also low.

Work continued during FY 78 to demonstrate that the trained pigeon would adapt to the environmental conditions of a helicopter in flight and continue to perform the previously trained search-detect-report task. The results of this effort follow.

METHODOLOGY

SUBJECTS

Four pigeons (*Columba livia*) were trained to peck a response key when the orange target was presented at increasing distances up to 700 metres. They were also conditioned to perform the visual task in an environment which simulated the noise and vibration characteristics of a helicopter. The pigeons were maintained throughout the year at about 80 percent of a free-feeding weight. This level of weight has been found to be safe and behaviorally productive. (Reynolds 1968)

HARDWARE

An observation chamber was fabricated. A peck key, a feeding mechanism and a pigeon couch were fitted into each of three equally-sized compartments within the chamber. Figure 1 illustrates the approximate dimensions of the chamber. Figure 2 illustrates the approximate visual fields for the three compartments and the degree of overlapping visual fields. Secure attachment of the observation chamber to Marine Corps' HH46A helicopters* was accomplished by twist keys located forward and aft on the top plate of the chamber. This plate fitted into the recess normally closed by the "hell-hole" hatch.

Attachment to the Coast Guard's H52 helicopter** was by means of a frame bolted to the cargo sling pad eyes. The chamber slid onto and was secured by straps to the attachment frame. Figure 3 illustrates this arrangement.

The target used during helicopter training and test was a spherical orange fishing float, 37 cm in diameter. Responses by the pigeons were displayed to the trainer by a counter and panel lights. A four-channel strip-chart recorder (Davis Rustrak) was used to record responses of the pigeons and detection of the target by a human observer. Toggle switches enabled control of feeders and strip-chart recorder functions. Control circuits utilized 28 VDC.

PROCEDURES

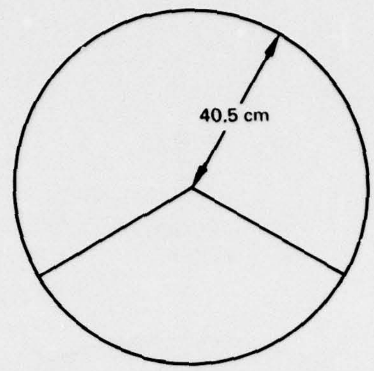
Training and test sessions were conducted in the following format: Each pigeon was weighed prior to the start of the session. With the observation chamber installed, the helicopter would fly to the work area, usually seven to ten miles north of the Kaneohe Marine Corps Air Station. On three flights with the Coast Guard the work area was five to ten miles southwest of Nanakuli, Oahu. The target was thrown out of the aircraft and the position was noted, using TACAN, if available, and geographical sightings. The aircraft then flew seaward, away from the target. During the first seaward leg the pigeons were placed in the observation chamber. Minutes later, the aircraft turned around and flew toward the target for the first trial of the flight. Four to six approach trials were conducted on each one- to two-hour flight. The interval between approaches ranged from about two minutes to about 45 minutes.

During early training sessions the altitude and flight speed were at about 30 metres and 30 knots. As the birds' behavior improved during subsequent training sessions, the altitude was increased to about 150 metres and the airspeed to about 90 knots. During test sessions, the aircraft flew at about 140 metres altitude and about 75 knots airspeed. For each trial the pilots were requested to have the target pass to the right or left of the aircraft

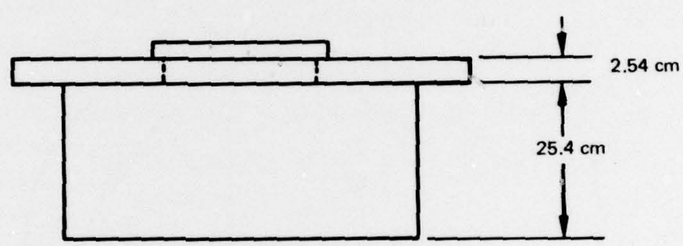
---

*The Kaneohe Marine Corps Air Station's Station Operation and Maintenance Squadron (SOMS) provided test flight time on a not-to-interfere basis in support of the Sea Hunt. One of SOMS main duties is search and rescue for all airfield operations. SOMS personnel are specially trained and the helicopters specially configured for this duty.

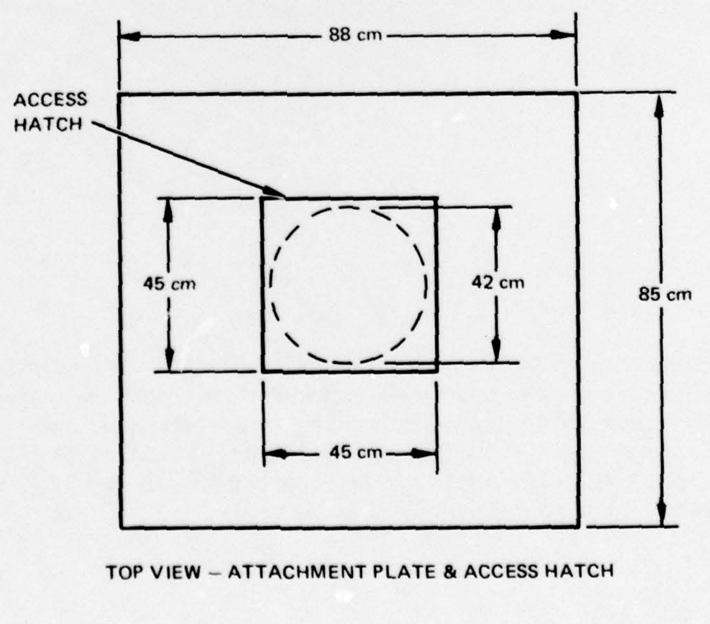
**Flight time was provided by the Barbers Point Coast Guard Air Station on a not-to-interfere basis.



TOP VIEW OF BIRD COMPARTMENTS



SIDE VIEW OF CHAMBER W/ ATTACHMENT PLATE



TOP VIEW – ATTACHMENT PLATE & ACCESS HATCH

Figure 1. Approximate dimensions of flight chamber.

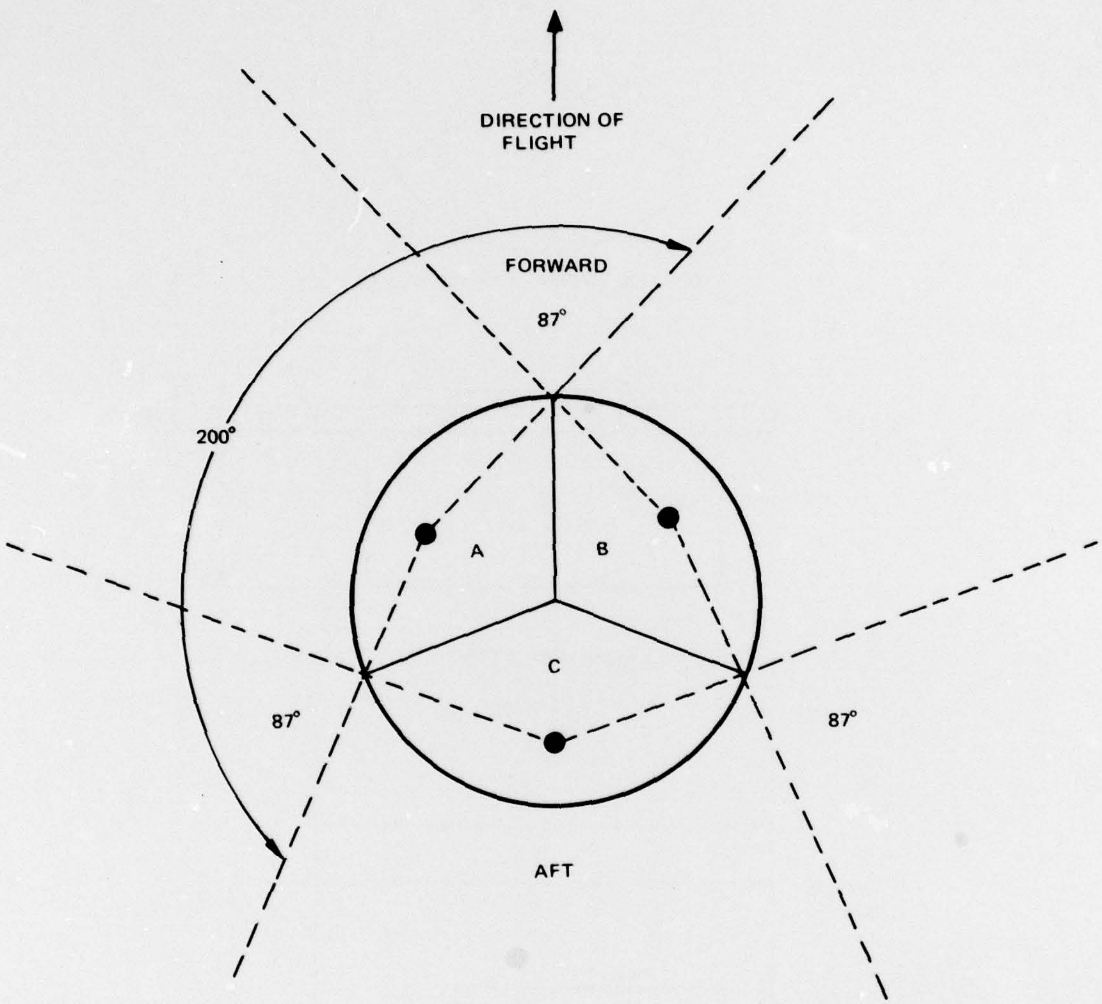


Figure 2. Approximate visual fields of the pigeon in each compartment. The position of each pigeon's (A, B, or C) head is indicated by the small closed circle within each of the three compartments. The visual field for each bird is about 200 degrees, as is indicated by the area between the dashed lines extending from the closed circles. Bird A shares the most forward area with bird B and the left aft area with bird C; likewise, bird B shares the right aft area with bird C. Since each bird shares about 87 degrees of the viewing area with the adjacent bird, six areas are thereby discriminable.

Figure 3. Attachment of the flight chamber to the Coast Guard H52 helicopter.

on the first inbound pass. During the Marine Corps sessions, two pilots and two crewmen were aboard; thus there were two observers on each side of the aircraft. Two pilots and one crewman were employed during Coast Guard sessions. The participating Marine Corps and Coast Guard personnel had been trained for search and rescue. All persons aboard were asked to search actively for the target and call out its position when sighted. The trainer monitored the pigeons' performance and gave directional information to the helicopter crew when a detection by a pigeon occurred. If the target was not sighted by aircraft personnel on the first pass, the aircraft circled the area until the target was seen.

The trainer recorded for each trial: (1) when the aircraft crew or Sea Hunt System made the first sighting, (2) the clock position of the target when first sighted by a crewman, and (3) the pass number when the target was detected by the Sea Hunt System and by the crew (several passes could occur during each approach trial). For each first pass by the target a hit was scored for the pigeons if one of the birds responded, and a hit was scored for the aircrew if a crew member called a sighting. A miss was recorded for the pigeons if none of the birds responded during the pass, and for the aircrew if no one sighted the target before turning to make the second pass. Thus, if the target was not sighted by the birds or aircrew during the first pass, a miss was recorded for both.

The pigeons performing correctly were reinforced with pigeon food after a detection was substantiated by a human observer onboard the helicopter. At the end of each training or test session, the practice target was recovered by the hovering helicopter, using a grappling hook to snag a floating line attached to the target.

RESULTS

Helicopter flights began on 19 December 1977 with the Marine Corps and 14 July 1978 with the Coast Guard. Eighty-one flights were conducted throughout the year: 73 with the Marine Corps and eight with the Coast Guard.

Twenty-two test flights were conducted during July, August and September 1978, using Marine Corps and Coast Guard crews and helicopters.

A total of 97 approach trials were made to the target. Eight trials were deleted from analysis because of incomplete data recording by the trainer, equipment failures, or because unexpected orange objects confounded the data. Table 1 summarizes the data collected on 89 trials, combined Marine Corps and Coast Guard, and for Marine Corps (63 trials) and Coast Guard (26 trials) separately. Only data from the first pass by the target on each of the trials are presented. Data from subsequent passes, often necessary for the human observers to visually locate the target, are not included.

The birds detected the target on the first pass in 80 of the 89 trials; in 67 of the 80 trials the birds reported the target before the human observers. While the human observers reported the target on only 34 of the 89 trials, during the first pass on just 12 of the 80 trials were the human observers first to see the target. Thus, the birds were not only reporting the target more often, but were doing so generally before the human observers.

Table 1. Detection performance on the first pass of 89 trials. Absolute ratios included in parentheses. Sample size (n) is also indicated.

Percent Detection On lst Pass By:	Marine Corps Trials	Coast Guard Trials	Combined
Pigeons	87% (55/63)	96% (25/26)	90% (80/89)
Aircrew	40% (25/63)	35% (9/26)	38% (34/89)
On 1st pass detection trials, percent first to see target	n = 55	n = 25	n = 80
Pigeons	83% (46/55)	86% (21/25)	84% (67/80)
Aircrew	15% (8/55)	14% (4/25)	15% (12/80)
Same	2% (1/55)	0% (0/25)	1% (1/80)

The following facts should be kept in mind when examining these data: (1) both pigeons and human observers could have seen the target on the first pass, regardless of which were first to detect it; (2) a first sighting by the pigeons guided the search of the aircraft personnel; the human observers were "told" where to look by the trainer, based on the birds responses; and (3) aircraft personnel had prior knowledge of the target's approximate position and could relax between trials.

Subjective judgments of the environmental conditions during the tests were based on wind speed, cloud cover, visibility,and precipitation. Good conditions were characterized by normal tradewinds, less than 60-percent cloud cover, and no precipitation. Poor conditions were characterized by high wind, rain, and 60- to 90-percent cloud cover. Sea states were determined by matching the observed ocean state with a sea state key (Anonymous, 1978). About 82 percent of the test flights were conducted during good weather.

Table 2 lists the mean number of passes on each trial required to detect and localize the target for the birds and human observers during different sea state conditions.

Table 2. Detection performance occurring during different sea state conditions.

Mean ($\bar{x}$) Passes Requi[illegible] to Locate Target
(n = trials, s = standard deviation)

Sea State	Pigeons $\bar{x}$	Pigeons s	Human Observers $\bar{x}$	Human Observers s
0 (n = 5)	1.0	0.0	2.2	1.3
1 (n = 14	1.0	0.0	2.6	1.8
2 (n - 30)	1.2	0.4	2.3	1.4
3 (n = 23)	1.1	0.3	1.8	1.0
4 (n = 17)	1.2	0.4	2.3	1.4

Larger sample sizes are needed to perform a correlation analysis between detection performance and sea state.

On 21 February 1978, during a training session, the birds located an orange-colored surfboard floating in open water east of Kahaluu, Oahu. A small, red/orange-colored shipping crate was found during a training session on 28 February 1978. While on a session with the Coast Guard west of Nanakuli, Oahu, the Sea Hunt System detected, before the aircraft crewman and pilots, fishing floats with small, red-orange flags attached. Several of the float-flags were found within the search area and were confused with the practice target by both the pigeons and the aircraft personnel.

Appendix A presents evaluations of the Sea Hunt System by the Station Operations and Maintenance Squadron of the Kaneohe Marine Corps Air Station and the Barbers Point Coast Guard Air Station of the Fourteenth Coast Guard District.

DISCUSSION AND CONCLUSIONS

The effectiveness of the Sea Hunt System in improving the probability of detecting the orange target is indicated in Table 1.* Not only were the pigeons detecting the target on the first pass at a higher probability than the human observers, but the pigeons' detections information (percent first to see target) also helped the human observers concentrate search efforts in the proper direction. Thus, the system integrated successfully with the procedures, hardware and personnel of search and rescue units of the Marine Corps and Coast Guard.

*Probability of detection values, commonly used to plan a search mission or to describe the effectiveness of a search mission, is a mathematical expression of the expected or experienced detection behavior of the observer (Natl. SAR Manual). The recorded ratios of detection behavior of the Sea Hunt pigeons in this sense can be referred to as probability of detection.

Although most of the test flights were conducted during good weather and low sea states, the pigeons performed satisfactorily on the few days when the seas were high and choppy and the weather was poor. The effect of sun glare was not plotted. Future tests should include a measure of this variable.

Several questions have been posed regarding the usability of the Sea Hunt System in its current configuration (appendix A). Some of these questions are unanswerable; e.g., how often are red, yellow or orange life vests worn? One might also ask how many boats, ships, and aircraft carry orange life vests just for that one-time emergency. Future efforts of a cost-benefit study should carefully determine the definition and measure of future benefit and the term of the return on the investment. Historical data should be carefully screened. For example, some reports may fail to record whether or not life vests were being worn, and if so, what color they were. On unsuccessful searches, of course, no one may know whether or not life vests were being used. The point remains: if there is any single visual aspect identified with and used for search and rescue, it is the color "international orange". And every airline traveling over water, every commercial vessel, most military craft, and probably most privately-owned aircraft and boats carry red, orange or yellow life vests or life rafts. The potential for use exists.

Although the pigeons are currently trained to report orange objects, efforts are underway to broaden the detection behavior to include red and yellow. It is anticipated that this effort will progress rapidly.

The efforts conducted during FY 78 demonstrate the feasibility of using trained pigeons, carried in an observation chamber attached to the underside of a helicopter, for search applications over water. Continued development efforts focusing on improvement of hardware and maintenance and on operational procedures are planned.

ADDENDUM

Since the initial preparation of the FY 78 report the following events have occurred. The present status of Sea Hunt is included.

By early 1979 three of the four pigeons had been successfully trained to detect red and yellow targets in addition to orange.

On 13 February 1979, the 14th Coast Guard District made a request to use Sea Hunt on a search for five men missing from a fishing trip. Actual use of Sea Hunt began the next morning. The author and Sea Hunt birds and equipment were picked up at Kaneohe, Hawaii. The search lasted all day, proceeding along the Hana Coast of Maui, the Hamakua Coast of Hawaii and part of the Alenuihaha channel between Maui and Hawaii. In several instances the birds detected, before crew members, several pieces of debris in the water that appeared orangish, but the debris proved to be a tree stump and other similar objects. On one occasion the birds reported a target, and although several circles were flown over the area, it could not be located by the crew.

A Coast Guard C-130 transported the author, Sea Hunt, and Coast Guard personnel from Maui to Oahu for the evening layover and returned them from Kaneohe to Maui the morning of 15 February 1979.

The search resumed at about 0900 hours on the 15th and was conducted along and out from the North Kona Coast of Hawaii. About 2.5 hours later the crew was forced to make an emergency landing without power about 2 miles off the Kona Coast. The observation chamber carrying the birds was torn from the helicopter and lost, along with the birds. The author and other crew members survived uninjured.

Currently, new birds are being trained, using funds provided by the Coast Guard Research and Development office. Design and fabrication of new helicopter equipment for Sea Hunt will be accomplished later in 1979.

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APPENDIX A

LETTERS OF APPRAISAL

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UNITED STATES MARINE CORPS
Station Operations and Maintenance Squadron
Marine Corps Air Station
Kaneohe Bay, Hawaii 96863

OMOT/FTF/sk
3100
5 Sep 1978

From: Commanding Officer
To: Mr. James V. SIMMONS, Naval Ocean Systems Center (Code 512)

Subj: Station Operations and Maintenance Squadron Support of Naval Ocean Systems Center Pigeon Project

Ref: (a) Mr. James V. Simmons inquiry of 1 September 1978

1. The reference solicited comments and recommendations from this command concerning the Naval Ocean Systems Center's (NOSC) pigeon research and development project. The purpose of this letter is to answer that inquiry.

2. Station Operations and Maintenance Squadron (SOMS) of Marine Corps Air Station, Kaneohe Bay, Hawaii was initially involved in this effort during August of 1977 when Mr. Ralph Kron of NOSC approached Captain F. C. Fowler of SOMS to discuss the feasibility of helicopter support for the pigeon project. Captain Fowler indicated that SOMS would provide helo support on a not-to-interfere basis with the SOMS Search and Rescue (SAR) mission. During October and November 1977, engineering technicians from NOSC worked with SOMS maintenance personnel to develop a pigeon observation chamber that is compatible with the HH-46A SAR airframe. This pigeon chamber was "test-flown" during December 1977 and required only minor modifications before the pigeons were actually flown for the first time.

3. The SOMS SAR helos have flown 80 missions for approximately 115 flight hours in support of the pigeon project. The bulk of these missions have been flown by the five permanently assigned SAR pilots. These five pilots have a combined total of 34 years of aviation experience and 11 years of search and rescue flying. They have a total of 7,000 flight hours among them. The consensus among these pilots is that the pigeon project has the potential of developing into an invaluable asset for the search phase of a SAR mission.

4. The profile of each "pigeon flight" is essentially the same. The aircraft is flown 9-10 miles out to sea so as to minimize the distracting effect of the island land mass and reduce possible assistance to the pigeons. An 18-inch diameter international-orange buoy is dropped into the water and a TACAN fix is taken to mark the location of the buoy. The aircraft is then flown roughly five miles further out to sea and the pigeons are placed in the observation chamber. The pilots then attempt to fly the aircraft on such a course as to place the buoy to the left or right of the flight path. As the aircraft is flown toward the buoy, all four

OMOT/FTF/sk
3100

Subj: Station Operations and Maintenance Squadron Support of Naval Ocean Systems Center Pigeon Project

aircrew members begin visually searching for the buoy. In approximately seven of ten of these runs the pigeons acquire the buoy prior to visual sighting by crew members. As a result of the pigeon contact, all hands begin visually searching the quadrant the pigeon has indicated. It is frequently necessary for the aircraft to orbit the area several times before crew members sight the buoy. After pilots visually acquire the buoy, the aircraft is turned back out to sea and the "run" repeated. By pilot estimation, the pigeons alert on the buoy 70% of the time before human visual contact is made, and the pigeons' quadrant information then simplifies the visual acquisition of the target.

The consensus of the pilots who have flown this mission is that the pigeon apparatus will be a great aid in search missions off shore. The rapid onset of human eye fatigue is a well documented fact. The crew members of a SAR aircraft are constantly switching from aircraft instrument surveillance to air traffic surveillance to surface surveillance and back again. This constant readjustment of eye focus is extremely tiring and results in "void" areas in the crew members' visual search area. The addition of pigeons to the mission would greatly reduce those "void" areas and would therefore facilitate more rapid detection of a victim floating in the water.

/s/ R. E. Donaghy
R. E. DONAGHY

-COPY-

UNITED STATES MARINE CORPS
Marine Corps Air Station
Kaneohe Bay, Hawaii 96863

OMO/FTF/sk
3100
22 Nov 1978

From: Commanding Officer
To: Commander, Naval Ocean Systems Center, San Diego, CA 92152

Subj: Evaluation of Project Sea Hunt by Station Operations and Maintenance Squadron (SOMS)

Ref: (a) Commander, NOSC ltr JFF:ak 3900 ser 512/152 of 16 Oct 1978

1. The reference solicited comments from this command concerning the Naval Ocean Systems Center's (NOSC) Project Sea Hunt. The purpose of this letter is to answer that inquiry.

2. Station Operations and Maintenance Squadron of Marine Corps Air Station, Kaneohe Bay, Hawaii was initially involved in this effort during August of 1977 when Mr. Ralph Kron of NOSC approached the Operations Officer of SOMS to discuss the feasibility of helicopter support for the Sea Hunt project. SOMS agreed to provide helo support on a not-to-interfere basis with the Search and Rescue (SAR) mission. During October and November 1977, engineering technicians from NOSC worked with SOMS maintenance personnel to develop a pigeon observation chamber that is compatible with the HH-46A SAR airframe. This pigeon chamber was "test-flown" during December 1977 and required only minor modifications before the pigeons were actually flown for the first time.

3. The SOMS SAR helos have flown 90 missions for approximately 132 flight hours in support of Sea Hunt. The bulk of these missions have been flown by the five permanently assigned SAR pilots. These five pilots have a combined total of 34 years of aviation experience and 11 years of search and rescue flying. They have a total of 7,000 flight hours among them.

4. The profile of each "pigeon flight" is essentially the same. The aircraft is flown nine to ten miles out to sea so as to minimize the distracting effect of the island land mass and reduce possible assistance to the pigeons. An 18-inch diameter international-orange buoy is dropped into the water and a TACAN fix is taken to mark the location of the buoy. The aircraft is then flown roughly five miles further out to sea and the pigeons are placed in the observation chamber. The pilots then attempt to fly the aircraft on such a course as to place the buoy to the left or right of the flight path. As the aircraft is flown toward the buoy, all four aircrew members begin visually searching for the buoy. In approximately seven of ten of these runs, the pigeons acquire the buoy prior to visual sighting by crew members. As a result of the pigeon contact, all hands begin visually searching the quadrant the pigeon has

indicated. It is frequently necessary for the aircraft to orbit the area several times before crew members sight the buoy. After pilots visually acquire the buoy, the aircraft is turned back out to sea and the "run" repeated. By pilot estimation, the pigeons alert on the buoy 70% of the time before human visual contact is made, and the pigeons quadrant information then simplifies visual acquisition of the target.

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/s/ M. H. Sautter
M. H. SAUTTER

-COPY-

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
Commanding Officer
Coast Guard Air Station
Barbers Point, HI 96862
Phone: 808-682-2621

3960
27 September 1978

From: Commanding Officer, Coast Guard Air Station Barbers Point
To: Commandant (G-DSA-3)
Via: Commander, Fourteenth Coast Guard District (o)

Subj: Evaluation of Naval Ocean Systems Center Project SEA HUNT

Ref: (a) COMDT (G-DSA-3) ltr 3900 of 9 JUN 1978

1. In accordance with reference (a), I have been assisting Mr. James Simmons of NOSC in the pigeon research and development project named SEA HUNT. Thus far 20 HH-52A hours have been devoted to this project which I consider to be a worthwhile effort of possible value to the Coast Guard.

2. To date a U.S. Marine Corps HH-46A and the Coast Guard HH-52A have been involved in evaluation flights. The profile of each "Pigeon Flight" is to fly approximately 7 to 8 miles offshore and drop an 18 inch diameter international orange buoy. The helicopter is then flown about 5 miles seaward from the target and the pigeons are placed in pod compartments located underneath the helicopter. Three birds are located in individual compartments to cover aircraft sectors 000–120, 120–240, and 240–360 degrees respectively. The pilots then reverse course and attempt to relocate the buoy. Each run is planned to pass within 1/2 mile of the target at an altitude of approximately 500 feet. As the helicopter approaches the target, all crewmembers search for the buoy with the exception of the NOSC evaluator who monitors the pigeon reactions and crewmember reports. Left, right, or aft directions can be given to the pilot depending on which pigeon has sighted the target.

3. The pigeons have sighted the buoy on the first pass 97 percent of the time compared to the crewmembers 30 percent. In 77 percent of all passes the pigeon has been the first to acquire the target. Several orbits are sometimes necessary to visually acquire the target after the pigeon in a particular sector has made the sighting.

4. The consensus of my pilots, and I agree, is that the pigeons are much more efficient than humans in searching for small objects of a specific color. It should be obvious that the smaller the target, the more difficult it is to detect with the human eye. In addition, pilots and crewmembers are concerned with monitoring aircraft systems and other inflight duties, and cannot devote 100 percent of their time to the search effort. Thus a very small target

can be easily missed. The major question in my mind about this project is what should the pigeons be trained to search for? Unfortunately most small boats are white or various shades of blue or aqua and blend in very well with whitecaps and water. In what percentage of our cases are we likely to be searching for something orange? Even though PFD's are orange, how often are they used? Most overdue boat cases I've been involved with were due to boat disablement from engine failure, battery trouble, out of gas, etc. When located, the PFD's were not visually being worn even though they were available. Usually the PFD's were stuffed up under the bow. Mr. Simmons stated that pigeons have been trained under laboratory conditions to search for shapes. He stated that the training is more difficult and that it hasn't been field tested.

5. I recommend continued support for the program and estimate, operations permitting, that I could devote 50 HH-52A flight hours toward this project during FY 1979. Additionally, I suggest that CGAS Barbers Point in coordination with CCGD14 (osr) and NOSC evaluate the existing system on operational SAR cases, where time and conditions permit. I further suggest that CG Headquarters conduct a cost-benefit study to answer some of the questions I posed for its usefulness in the real world of SAR. The analysis might use a scenario similar to that of the MRS sensor packages, i.e., procurement of a limited number to be placed at optimal locations. The analysis should also look at how it will complement/compete with other forthcoming sensors. From the figures given to me by Mr. Simmons, the development costs are cheap, and where else are you going to get superior, expert searchers to work for "chicken feed"?

/s/ J. E. Foels
J. E. FOELS
Acting

Copy to:
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